

SCIENCE

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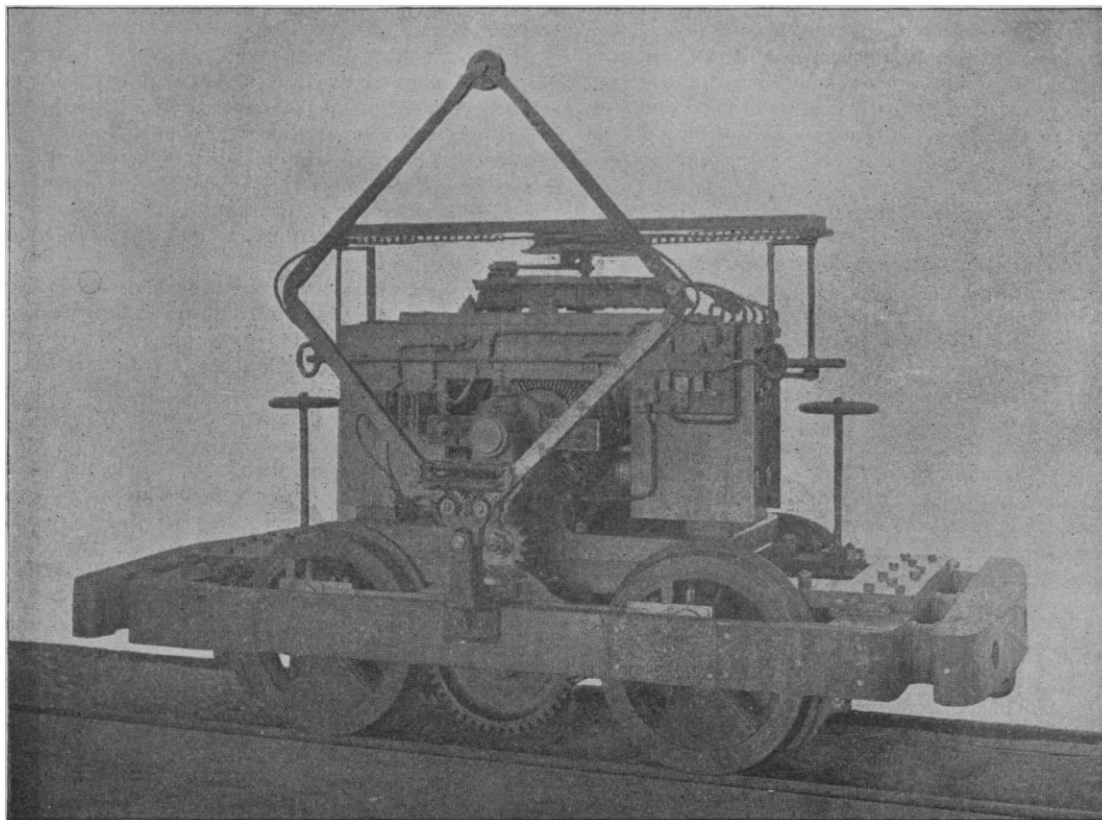
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ELECTRICITY IN MINING.

THAT the electric current can be easily adapted to mining and engineering operations is a fact which is abundantly attested by mines in which it has already come into general use for both lighting and transmission of power. The contrast between the wire-rope, compressed-air, and other methods, with electrical transmission of power, cannot fail to be in favor of the latter system. Existing water-powers miles away from the mines may be used, and electric motors employed for hoisting, haulage, pumping, ventilating, and many other purposes, with greater ease and economy

operation on a three-foot gauge, is 9 feet 7 inches in length over all, width 5 feet 3 inches, and height 5 feet 6 inches. Although the weight is 10,500 pounds, there is not a pound of it which is not utilized in the construction of the machine; and the tests for traction which have been made have given the most excellent results. The speed is six miles an hour under full load.

The motor used is the type "G" railway motor, 40 horse-power, embodying designs and inventions of Mr. Charles J. Van Depoele. Its motion is transmitted to the wheels by gears and connecting rods. On the top of the machine is placed a rheostat controlled by the wheel shown at each end, and on the side is placed a revers-



THOMSON-HOUSTON ELECTRIC LOCOMOTIVE FOR COAL-MINES.

than could possibly be accomplished by any other method. In fact, it is safe to say that in the near future electricity will displace all other forms of motive power in mining operations where the conditions are at all favorable.

In this connection, it may be mentioned that the Thomson-Houston Electric Company has just completed a mining locomotive for the Hillside Coal Company, Scranton, Penn., which is shown in the accompanying illustration. The machine embodies new features in motor-construction and in general design, and under practical test has shown that it is particularly adapted to the nature of the work required of it. The locomotive is made for

ing-switch, which can be operated in the same way from either end.

One of the distinctive features is the trolley-arm, which will operate with equal facility in either direction; and its method of construction permits a great variation in the height of the conductor. This is a very important and valuable feature, as in mining-work the conductor is rarely maintained for any length at a constant height. The Thomson-Houston Electric Company has already made in mining operations many applications of its electrical apparatus, which has been found to possess the same characteristics of excellence shown in its well-known lighting systems.

EVOLUTION OF MUSIC FROM DANCE TO SYMPHONY.¹

A BLUE egg may become a robin. The latent life sequestered by marble walls may be warmed into activity, and gather to itself the crumbs from a cottage table, and weave therefrom the tissues of life, — feet to perch among the blossoms, wings to fly among the trees, eyes to revel in the scenes disclosed by sunlight, and vocal organs to sing the song of love to mate.

A tiny seed may become a "big tree;" for, warmed into life, it sends its rootlets into the nourishing earth and its branches into the vivifying air, and gathers materials with which to build a *Sequoia*, that stands for centuries as a glory in the forest of the sierra.

The rill born of a summer shower carries the sand from the hillside and gives it to the brook, and the brook bears it on to the river, and the river transports it to the sea, and the impregnated tide finds a nest beneath the waves and in it lays the egg of an island. Then this boss on the floor of the ocean has the power to gather about it more sands as they come from the distant hills, and still more sands. Every summer shower gives it more, and every storm adds to the sands that are thus buried beneath the sea, until at last an island is hatched, as it lifts its head above the waves.

Robins grow to be robins by minute increments; trees grow to be trees by minute increments; islands grow to be islands by minute increments. There is an aphorism current in the world that like begets its like: it is but half the truth. Whatever is, changes, and no repetition comes through all the years of time: some minute change must ever intervene. Among living things one generation follows another, always with some change; and change on change in sequent reproduction, as the stream of life flows on, results at last in transformation. This slow but sure metamorphosis is called evolution, and the scientific world is engaged in the formulation of its laws.

The laws of animal and vegetal progress, otherwise called biotic evolution, do not apply to mankind in civilization. Biotic evolution is progress in bodily function: human evolution is progress in culture. The one is dependent on the laws of vitality; the other, dependent on the laws of psychology. The first great law of biotic evolution is denominated "the survival of the fittest in the struggle for existence." This law does not directly apply to man in his progress in culture. The bad are not killed off by any natural process in order that the good may survive and propagate their kind. Human progress is by human endeavor, by conscious and designed effort for improvement in condition.

The second great law in biotic evolution is denominated "adaptation to environment." But man is not adapted to environment: he adapts the environment to himself by creating that which he desires. For example: no natural protection to his body is developed by which he is adapted to a boreal climate; but he adapts that climate to himself, modifies it in its effect upon himself by building a house and creating a home climate at the fireside, and when outside of his home he protects himself with clothing, and creates a personal climate, and laughs at the winds that drift the snow. Man is not adapted to environment; but he adapts his arts to environment, and creates new conditions to please himself.

The third great law of biotic evolution is denominated "progress in heterogeneity." With time, animals become more and more diverse in structure and function. Kinds or species multiply. But this law is reversed with men in civilization, for they become more and more homogeneous. The tendency is not to differentiate into species, some with horns and hoofs, some with tusks and claws, and some with arms, and some with wings. The tendency is not towards specific differentiation, but towards specific homogeneity.

There is, however, another kind of differentiation that develops by culture, which may be denominated "qualitative differentiation." Human beings do not develop along divergent lines, but along parallel lines, and they differ mainly in the degree in which they have made progress. Human evolution develops not different kinds of

men, but different qualities of men. The apple-tree under human culture does not develop in one line to bear peaches, another to bear plums, and another to bear pine-apples: but the fruit of one tree is sour, and that of another is sweet; one is dwarfed, gnarled, and bitter, another is large, roseate, and luscious. Human progress is such culture. It develops different qualities and degrees of the same thing. There are apple-trees that bear nothing but sorry fruits. There are tribes of the world that are all savages. The trees of higher culture bear fruits of diverse qualities. The well-developed pippin, the diseased pippin, and the shrivelled knot of bitterness grow on the same tree. So in lands of highest culture men are good and bad, wise and unwise, but they do not thus become specifically different.

The fourth great law of biotic evolution is denominated "progress in integration." The differentiating parts also become more and more interdependent. The organ which can best subserve its purpose is less efficient in performing an unwonted function: it therefore becomes dependent upon other organs, and the interdependence of all the parts of the same organism increases with evolution. Society is an organism. The people organized as a body politic, and constituting a nation, become interdependent, and each one is interested in the common welfare. In the growth of society through the organization of kindred into clans, and of clans into tribes, and ultimately of tribes into nations, great progress in integration is made, and it receives its highest development when despotism is organized. If we study the progress of society through these stages only, we are led to conclude that biotic evolution and human culture follow the same laws, for the integration of mankind in despotic nations is measured by the perfection of despotic governments. The highest integration is secured with hereditary rulers, privileged classes, and enslaved common people.

The progress of mankind from despotism to liberty has been one vast system of warfare against integration, until in perfect liberty under free institutions this integration is destroyed, and the biotic law is repealed in its application to mankind. The development of liberty is the overthrow of the fourth law of animal evolution.

Liberty means freedom to the individual, and is secured by establishing interdependence of industries: thus man transfers despotism from himself to his inventions.

No cruel law of destruction belongs to mankind. No brutal adaptation to environments occurs in the course of human culture. No differentiation into antagonistic species is found. And liberty destroys despotic integration.

The laws of biotic evolution do not apply to mankind. There are men in the world so overwhelmed with the grandeur and truth of biotic evolution that they actually believe that man is but a two-legged beast, whose progress in the world is governed by the same laws as the progress of the serpent or the wolf; and so science is put to shame.

Since the doctrines of evolution have been established, the basis of systematic classification has been changed. Artificial categories have given place to natural categories in such a manner that the classes are believed to represent genetic relations. The search for natural categories began anterior to the establishment of the laws of biotic evolution, and the new philosophy would be unrecognized but for the work which systematic biology has already done. Natural classifications and the laws of hereditary descent develop together, and are interdependently established. Still it remains that genetic biology, or the science of the laws of the progress of life, imposes conditions upon systematic biology; for a natural classification must reveal the fundamental epochs and phases of evolution.

As human progress is not upon divergent lines, but upon the same line to the goal of a higher life, men must be classified, not by biotic kinds, but by degrees of culture; and the three great culture stages, not three great kinds of men, be it understood, have been called savagery, barbarism, and civilization, to which a fourth may well be added, that of modern civilization, — the stage of enlightenment.

That which makes man more than the beast is culture. Culture is human evolution; not the development of man as an animal, but the evolution of the human attributes of man. Culture

¹ Address by Major J. W. Powell, the retiring president of the American Association for the Advancement of Science, delivered at the meeting in Toronto in August.

is the product of human endeavor. This is the burden of my argument.

In man's progress from savagery to enlightenment, he has transferred the laws of beast evolution from himself to his inventions, and, relieved of the load, he has soared away to the goal of his destiny on the wings of higher laws.

The evolution of music has been presented as an illustration of this fact. Man as a poet has not developed by the survival of the fittest. There has been no natural system of laws by which the bad musician has been killed, and the good musician permitted to live and propagate his kind. There has been no system of natural selection to kill poor singers and cheap fiddlers.

There is no adaptation of musicians to environment. There are no aquatic musicians; there are no aerial musicians; there are no tropical musicians; there are no boreal musicians — as those terms are used in biology. The prima donna that sings in Rome may sing in St. Petersburg. The artist on the violin may enrapture the people in Toronto, in Washington, or in Mexico, and an orchestra may play on the land and on the sea.

Again, there has been no progress in the differentiation of musicians. There is no musical species. There is no distinct race of prima donnas. There is no endogenous clan of organists. Musical folk spring up among the people everywhere. Of two children of the same parents, the one will be musical, and the other will not be. A sister will play the violin with beauty, and a brother may love nothing better than an accordion.

Every nation and tribe on the face of the earth has developed its own musicians; and when a great artist springs up in any land, he travels the world, and delights all the people of civilization. Ole Bull, like Orpheus, would make the stony hearts of all men dance; and Jenny Lind could sing a song of sorrow to weeping multitudes in any city of Christendom, and, if the angels loved not her music, small be the meed of praise for angels.

And, lastly, there is no integration of musicians. They are not organized into one body politic. They do not inhabit one little nook of the world. They are not gathered by themselves on one isle of the sea. The king of players is metaphoric king, the queen of singers is metaphoric queen.

But though these laws of evolution do not apply to musicians, they do apply to music itself. Man has transferred them from himself to his musical inventions. Ever there has been a survival of the fittest. The music of savagery is lost in barbarism. The songs of barbarism are lost in civilization, and modern music is replacing the music of our fathers. So the old grows into the new by the survival of the fittest; not by natural selection, but by human selection, for men choose to keep the music they love the best.

There has been progress by differentiation in music. Gradually music has developed into distinct parts; and with the invention of musical instruments, musical compositions have been produced adapted to each. There is the music of the organ, the piano, the flute, the violin, and instruments too many to tell, and thus the world is filled with varied music.

Music has been adapted to environment. There is music for the dance and for the battle; music for the wedding and the funeral; music for the theatre and the temple; and there is music about every thing, — the land, the sea, and the air, the valley and the mountain, the flower and the forest, the fountain and the river, the worm and the serpent, the zephyr and the tempest. There is music for all peoples, in all climes, in all conditions. The varieties of music parallel every human thought.

There is integration of music. When a band plays organized music for the military parade, many instruments combine to play their parts in harmony. There is organized music for the temple, where the choir and the instruments combine to make music for prayer and praise. But the highest development of musical integration is found in the orchestra, where the parts of the symphony are played in sweet unison, in grand harmony and sublime sequence, guided by the magic *baton* of the leader.

Music is the invention of mankind; not of one man, but of all men, — of composers, performers, and hearers. Music has come down the stream of time; and as the rivers grow from source to sea, so music grows from primal time to vast eternity.

In the same manner we may take up any one of the elements of human culture, and develop the laws of its evolution, and find that all culture comes by human endeavor. All arts, all institutions, all languages, all opinions, have grown in obedience to the laws of evolution as set forth; and in the exercise of all these human activities man himself has been developed: so the laws of biotic evolution apply not to mankind. Beast is beast, man is man.

I have affirmed that the laws of biotic evolution do not apply to human culture. To make this clear, concrete demonstration is necessary. On this occasion one of the æsthetic arts will be used for this purpose. The evolution of music will be portrayed and its laws developed, and it will be followed briefly through the four stages of culture, — savagery, barbarism, civilization, and enlightenment.

The classic categories of biology should represent genesis by differentiation, but it has been shown that man cannot thus be classified. Man by his genius has transferred the application of the four great laws of biotic evolution from himself to his inventions. Human inventions evolve by human selection; and there is a survival of the fittest, an adaptation to environment, a progress in differentiation, and a progress in integration. Human inventions, therefore, should be classified in such a manner as to exhibit their genesis by differentiation.

If we classify the fine arts on these principles, we must place them in four groups, as we find them arising from four germs. It is true that their development has been more or less interdependent, yet they have four origins, and have developed along four lines, both in form and motive.

Fetich carving was the germ of sculpture. Stone, bone, shell, wood, and various other materials, were used by the sculptor in which to carve the forms of his beast gods. Carving begun in this rude way developed at last along two lines, one leading to idolatry, and the other to sculpture.

Picture-writing was the germ of painting. Early man daubed rude pictures on bark and other materials, and etched them on stone. The alphabetic arts also sprang from this source, as writing, printing, and telegraphing.

Mythology was the germ of drama. Early man believed the animals to be the creators and movers of his universe, and the stories of the doings of beasts constituted the first drama. Later romance sprang from the same source; and from romance, biography and history. Along another line from the same germ sprang science.

The dance was the germ of music and poetry. Poetry derived its form from the dance, and its earliest motive from mythology. The evolution of music will be set forth more fully.

Sculpture represents material forms in solid matter, as wood, clay, stone, ivory, and metal.

Painting represents forms and scenes of nature and human life in color, as light, shade, and hue, through the aid of form perspective, distance perspective, and aerial perspective.

Drama represents scenes in the life of human and mythic heroes by personation or mimicry combined with literary presentation.

Romance represents biography and history in fictitious tales.

Music represents ideas in sound by rhythm, melody, harmony, and symphony.

Poetry represents psychic pictures by metaphor, through the aid of rhythmic literature, sometimes using rhyme and alliteration.

The arts have thus been described by defining their forms; but each has something more as a reason for its being an æsthetic art, — a purpose to fulfil. The motive of all the æsthetic arts is to reach the intellect through symbols, and thus kindle the emotions. All art is therefore symbolic and emotional.

Let us turn to the evolution of music.

This is the burthen of my song, this is the theme that runs through my melody: that music, in harmony with all of the processes of becoming in nature and art, becomes by minute increments, — by growth. How, then, did music grow?

It has been assumed by writers that music has its origin and development in the innate appreciation of the human mind for the rhythms, melodies, harmonies, and symphonies of nature; that it

is the spontaneous outburst of the human soul in response to the music of the physical and animal world. The sighing of the winds, the murmur of the rills, the roaring of the cataracts, the dash of the waves on the shore, the singing of the forests, the melodies of birds, — all these and many more have been considered as the teachers of music to man. The objective study of music among the lower tribes of mankind and among the various peoples of the world in different stages of culture, and of the history of music itself as developed by our own race, leads to a different conclusion.

Kids gambol among the rocks as if filled with joy; colts run about the pastures as if mad with ecstasy; cooing babes pommel vacuity and kick at void with hands and feet as pink and soft as petals of the rose, and seem delighted with the gift of new-born life; lads and lasses play in the park with shouts and laughter, as if existence was forever a May-day of sport.

There is pleasure in activity. The laboratory of life evolves a surplus of motion the expenditure of which gives rise to joyous emotions expressed in rollicking, boisterous play.

In youth and health and vigor there is in the exercise of the muscles and the motions of the limbs a joy which may be heightened as many become associated in the same activities, — brothers, sisters, cousins, sweethearts, wives, husbands, and parents. Let them unite in sportive activities, and the very ecstasy of motion is produced. When such physical activities are systemized, the dance is organized. When a group of pleasure-seekers organize their activities in such a manner that the motion of every one is in harmony with the motion of every other one, the merry dance is an art and a social institution, and every one's joy is multiplied by every other one's joy. Then rhythm of motion becomes rhythm of emotion.

Man early learned that it was easier to control movements of dance by sound than by sight, and so he marked the rhythm of the dance by sounds of the voice or by sounds of the drum.

Blue-eyed children play with the brown-eyed, and brown-eyed children play with the black-eyed, and they all join hands and play "ring-around-a-rosy;" and out of this childish sport, by minute increments, musical rhythm becomes.

The first dancers were the men who lived in the forests, around the sheltered bays of the sea, on shores where quiet lakes mirrored the wild bird's flight, or on banks where the fishes sported in the wavelets of the brook.

The Eden of these sylvan men was large. It was walled with ice, so that men could not wander away to the north pole or to the south pole; but between these frozen regions the temperate and torrid lands were open. Before they learned to fashion stone knives, before they learned to use stone tomahawks, before they learned to use bone awls, before they learned to wear shell beads, before they learned to build shelters of boughs and bark and stone, — while yet naked animals, — men were found in every quarter of the globe. There were men on every shore, and there were men on the banks of every river. Sylvan men and women, boys and girls of the forest, dusky babes of the wood, were scattered throughout the whole habitable earth before the rudest human arts were invented, probably before organized languages were formed, and probably before institutions were organized. How do we know this is true? Is it the story of a romancer who finds the origin of the glacial drift in the lashing of a comet's tail? No, this conclusion is reached through the labors of an army of patient, earnest, keen-visioned investigators. They have found the birthplace of art not alone in one land, but in all lands. The vestiges of the crudest arts are found everywhere, and men began the career of artisans everywhere. It is found that men were already distributed throughout the world when they first began to use the simplest tools. Something more of interest is found. It is discovered that the time when the first art-culture began was long ago, — very long ago; not long when compared with the geologic history of the earth, but very long when compared with the book-recorded history of man. Archæologists have found vestiges of the beginnings of human art in geologic formations, and they have found them in all lands. So the "Garden of Eden" was all the world, and the sons of Adam were a host.

As time passed on from that ancient epoch when men had

landed on every shore, they slowly, very slowly, improved in their arts: for later and still later geologic formations contain vestiges of higher and still higher arts, until at last men could make pottery and weave garments and cultivate the soil; and from that time on, we have human industry recorded in books.

Early human history is recorded in the rock-leaved bible of geology; late human history is recorded in paper-leaved books of libraries. Let us take up the story of music as a human art at the time when the late history commences, for that will serve our purposes.

All the sylvan people of the world rejoice in dancing. So far as we know, it was the earliest of the æsthetic arts, for we find it highly developed at the very birth of all other fine arts. This is because its foundation is laid in the physical constitution of man: it is the expression of the joy of animal life. These sylvan men danced by firelight, and forever they varied the rhythm of their dances with short steps and long steps, with steps to the right and steps to the left, with steps forward and steps backward: so dances came to be composed of a succession of varied steps, so rounded as to make a complete number in a figure of motion. A figure of motion, a complement of steps, is repeated over and over again, and the voices of the dancers are trained to chant the rhythm to guide their feet in the dance. To mark the varied steps to each complement or theme of motion, the voice is varied: long notes and short notes are used, and then loud notes and soft notes; and yet there is nothing but rhythm. Then they begin to vary their voices as a guide to the moving feet by changing the vocal pitch, and the simple chant becomes. First, the voice varies only in time; then it varies in time and stress; then it varies in time and stress and pitch, and the chant is almost a melody. So the music of the lowliest men known to modern investigators is but rhythm. It is the universal music. All music in all times is based on rhythm, but some music has more than rhythm. The music of the savage has been improved. The sylvan man developed the first element of music to a high degree.

At this stage the chant of unmeaning syllables undergoes change, for the emotions that are kindled by the dance are expressed in words, — first a few simple expressions of emotion, mere interjections, then exclamatory phrases, then exclamatory sentences, and the egg of poetry is laid.

This embryonic poetry is devoid of rhythm; for the rhythm yet belongs to the voice, not to the literature. The rhythm does not grow out of the words of the chant, but the rhythm of the chant is imposed on the words.

The stage of culture of this sylvan man is called "savagery;" and it is very long; and during all these centuries, and centuries of centuries, tribes of kindred men dance and chant. At the foot of the glaciers they have their homes, and walls of ice echo their chants; by mountain crags they have their homes, and the rocks echo their chants; in the valleys they have their homes, and the savannas are filled with their chants; in tropical forests they have their homes, and "the sounding aisles of the dim woods" ring with their chants.

When sentences are used to express the emotions kindled by the dance, the leader repeats the words and the people chant the refrain; and more and more he gains a freedom in composition, and he varies his chant with new sentences, iterating and reiterating the emotional theme. In this way poetry becomes, and we have dancing-master poets and dance songs. As the dancing-master poet varies his theme of poetry, so he varies his theme of music, and melody becomes. Poetry and melody are twins born of the dancing chant. Thus it is that "ring-around-a-rosy" becomes a song.

At first musical rhythm is an auxiliary of the dance: the rhythm of music and the rhythm of motion are partners. When unmeaning syllables are replaced by emotional words and sentences, music and poetry live together. Sometimes it is dancing and music only; sometimes it is dancing, music, and poetry altogether; sometimes it is music and poetry only.

So the grandchild of the dance and the child of the chant grows, and is emancipated from the control of dancing, and becomes an art associated with poetry. Priests sing as they perform religious rites, women sing as they grind at the mill, children sing at their

sports; and song, as rhythm and melody, exists during all the period denominated "barbarism."

When freedom comes to song, it starts on a new career. No longer chained to Terpsichorean feet, it soars into the realm of ideal emotion. The dance expresses the joy of exuberant life: the song expresses the joy of exuberant emotion. The dance carries the body through the merry maze: the song carries the soul on its way through the universe of thought.

If I would share my measure of joy with another, behold, my measure is still full, and more than full: it overflows. When song comes, men find, that, though the solo is beautiful, the chorus is more beautiful, and rapidly choral music is developed. At the time to which we refer there is no harmony, but only rhythm and melody. Yet the egg of harmony is laid, for in melody sounds follow one another rapidly, and ere one note leaves the ear another joins it. The waning sound mingles with the waxing sound as the embryo of harmony. Thus melody trains the ear to the appreciation of harmony.

There is still another element of harmony in choral melody. The voices of a varied concourse of people are diverse in pitch. The notes of man are low and resonant, like the voices of waves and winds; the notes of women are high and clear, like the voices of birds; while children pipe like bees. In folk-singing, groups of such voices unite, and the elements of harmony are developed. The village life of barbarism when the people form a body of kin and kith promotes this rudimentary harmony; for they meet as one great family, and join in many a festival that must ever lead to music and dancing.

And here another art assists in the development of music. The drama begins in savagery. The savage deifies the beast. To him the animals of the world are wonderful.

The eagle lives a life with which he cannot vie. It plays among the clouds, rests on the mountain-tops, and soars down to circle over the waves of the sea. The humming-bird poises over its blossom-cup of nectar like a winged spirit of the rainbow. The deer bounds away through the forest, and leaves the hunter lost in amazement. The squirrel climbs the tree, and plays about among its branches, and springs from limb to limb and tree to tree, and laughs at the sport. The rattlesnake glides without feet over the rocks, and in his mouth the spirit of death is concealed. The trout lives in the water, and flies up the brook as the hawk flies up the mountain. Dolphins play on the waves as children play on the grass. The spider spins a gossamer web; the grub is transformed into a winged beauty; the bee lays away stores of honey; the butterfly sports in the sunshine like a flower unchained from its stem. The air, the earth, and the waters are peopled with marvellous beings.

The folk-lore of the savage is a vast body of oral literature, in which these wonderful animals are the principal actors, and his book of creation is the history of the animal gods. The stories of these animal gods are dramatized; and the priest-doctors of savagery are the actors who play before the people, assuming the parts of beast gods. For this purpose they dress themselves in the skins of beasts, or wear masks that represent the forms and attributes of their deities. In recitations and dialogues, with much acting and mimicry, they represent the scenes of their mythology to the people. When poetry is born, they recast their stories in poetic form, and chant and sing their verses.

Drama plays a great part in savage and barbaric life. In the tales of the drama the philosophy of the people is embodied. It contains their history of creation. The human mind is ever interested in the origin of things. The desire to know is the fundamental impulse of the intellect. The wisest and best of all peoples, even among the tribes of sylvan men, devote their highest intellectual powers to the enigmas of creation; and as opinions are formed, they seek to teach them to others. Thus it is in savagery and barbarism that philosophy is embodied in drama, and taught to the people. In primitive society the drama is the school of religion; for there its precepts are taught, and its lessons are reflected in the theatrical mirror of life. The drama is deeply embedded in early culture, and is intimately associated with the intellectual growth of the race.

When the drama borrows aid from music, music itself is greatly

invigorated. With the new impulse it rapidly develops, and this is the manner of its growth:—

When the chorus is sung by skilled performers, the unskilled join in parts, adding a kind of refrain to the music, not by following the undulations of the melody in unison with the principal singers of the chorus, but by chanting on a note in harmony therewith; and thus harmony becomes.

To suit the conditions of the actors in the drama, harmonious parts are developed until one, two, or more accessory chants are produced; then these harmonious parts are developed from accessory chants to accessory melodies, more simple than the principal melody, which still retains the name.

In the music thus developed by our race there are usually four parts,—soprano, contralto, tenore, and basso,—and these are adjusted to four classes of voices.

Rhythm grows into melody, and melody grows into harmony: yet music is young, and music must grow, for it blossoms with the promise of becoming divine. Music is to become symphony. Harmony is a combination of co-existent melodies; but symphony in its broadest sense is a combination of sequent harmonies. At the song stage of music, men begin to recite stories, simple dramas, and intersperse their narratives with stanzas of song; then the narratives are chanted, and songs and chants are combined, chants and songs alternating. At this stage a body of sacred music is developed. From hymns grow anthems, and Bible passages are rendered in the solemnity of the chant and the majesty of the hymn, for chants and hymns alternate; and anthems by minute increments become oratorios, where Bible history is taught in a succession of chants and hymns, changing along the course of the oratorio to express the varied emotions kindled by the sacred story. The mythic drama of the Pagan world is represented by the oratorio of the Christian world.

The profane dramas that are recited and sung come to be chanted and sung with instrumental accompaniments. And then are produced the cantatas, or poetic stories set to music; and fugues, or musical dialogues, are composed; and nocturnes, serenade music laden with tender love. Then the cantata is developed into the opera as the drama is wholly set to music and the parts presented by *dramatis personæ*.

Men must laugh sometimes, for tragedy must be set in comedy, as precious stones are oftentimes set in filigree; and so the madrigal is developed, which is an elaborate musical composition of many parts, designed for the expression of tender and hilarious joy in alternating movements: it is the comedy of music. And then comes the sonata, designed for solo instruments,—a musical composition usually of three or more successive parts, each of which has a unity of its own, yet all so related as to form one varied and consistent whole. From the sonata, music passes to the symphony, which is a musical composition of successive parts having slightly varied but intimately related movements, treated in such a manner, by varying the time and stress and pitch, as to produce the greatest contrasts. With the anthem and oratorio, the cantata and the opera, the fugue and the madrigal, the sonata and the symphony, music has reached its highest stage in civilization.

The theme is the evolution of music, not the evolution of musical instruments; but something must be said of instruments, for they play an important part in the evolution of music itself. Were I to enter upon this theme fully, the task would be great. Then I should have to tell of thumpers of many kinds, by which the rhythm of the dance is controlled; I should have to tell of rattles, by which the dance is enlivened; and I should have to tell of whistles, by which the dance is made merry with screams. Then I should have to tell how thumpers became drums, and how rattles became tambourines, and whistles became flutes; and I should have to tell how twanged flexible strings became violins, and how twanged rigid strings became pianos, and how bark whistles became horns, and how pipes became organs.

The invention of musical instruments begins with the sylvan man, who uses them to mark the rhythm of the dance. Throughout savagery and barbarism only time-marking instruments are invented. Not till civilization came to the people of the shores of the Mediterranean were instruments of melody produced; but

when they appeared, a new world of music burst upon the delighted ears of civilized man. Beaten instruments, reed instruments, wind instruments, and stringed instruments give power and variety, and the capacity for musical production is marvellously increased. Men can sing solos, sing in chorus, and sing in parts within the compass of the human voice; but with instruments they can play in unison with like instruments, and in harmony with unlike instruments, and with a compass far exceeding that of the voice. Then music is enriched by increasing the compass, it is enriched by increasing the volume, but more than all it is enriched by increasing the variety of its kinds. At this stage music is sweet, music is grand — but music must become sublime.

Instruments of music are but instruments of melody until science comes, when it is learned that sound is a mode of motion, and that low sounds are slow vibrations, and high sounds quick vibrations. Then the knowledge comes by which man invents instruments of harmony, — co-existent harmony and sequent harmony. Thus science is the last great agency in the evolution of music, for it produces instruments by which symphonies become possible, and music has reached the sublime.

As the blue egg becomes a robin, as the seed becomes a *Sequoia*, as the sands of the rill become an island, so “ring-around-a-rosy” becomes a symphony.

Primarily feelings arise from biotic pains and pleasures. It is one of the wonderful transformations of nature that the pain of a blow should slowly, through the years of human culture, develop into the sorrow for sin; that the pleasure of a feast should evolve by the metamorphosis of minute changes into the love of justice. How feelings develop into emotions, and emotions into sentiments, and sentiments into aesthetics, is a long and beautiful story which cannot here be told. But the world is full of transformations. The metamorphoses of evolution have been the mysteries of time. In the solution of these mysteries, men have been engaged through untold years, — peering through their purblind primitive ignorance for more light, reasoning with guesses, philosophizing with myths, and believing in errors, but gaining a little truth here and a little there, until by minute increments science has been developed. The evolution of science is itself the mystery of mysteries, the metamorphosis of metamorphoses, for the germ of science is mythology.

With the development of intellect, the emotional nature of man by which he loves and hates has been evolved, and the æsthetic pleasures have arisen under the law of mental association. By association with the joys of life, music has been endowed with its power of producing emotion. This association must be explained.

I have now spoken of the growth of music as a combination of sounds in succession and in harmony, as it is made by the human voice, and have alluded to the origin of the instruments by which parlor, orchestral, and temple music is produced; but nothing has been said of the means by which music is endowed with its power to produce emotion. I have told of the body of music, but have said nothing of its soul. Music is freighted with joy and sadness, with hope and fear, with courage and cowardice, with glory and shame: it is freighted with all emotion; and how does the form of sound become informed with feeling?

When primitive man — poor, naked, houseless, savage man — lived in the Eden walled by ice, and was scattered throughout the garden of the world, his capacities for pleasure were yet little developed. Still he joyed much in his rude way. When the wind blew cold, he warmed himself by the camp-fire; and when the night was dark, he illumined his home with fire-light; and about the fire he danced, and in the dance he had resource of joy. When the fisherman came home laden with a bounteous catch, he made merry by the fire-light dance; when the hunter brought in many pheasants or many antelopes, then, with kith and kin, he made merry by the fire-light dance; when the rich nuts fell from the trees in bounty, he made merry by the fire-light dance; when the wind blew chill, he drove the cold away by the camp-fire dance, and when the night was about him he rejoiced in dancing. So the nights of that region where the stars of the Great Bear are overhead, and the nights of that region where the stars of Orion are overhead, and the nights of that region where the Southern Cross

is overhead, in all the habitable lands of the round earth — the nights were spent in dancing, and the rhythm of the dance and chant became the language of these rude savage emotions.

But disease and wounds and pain and death were the heritage of this early man. Whence these evils came he knew not; why they came he could not tell. How they were to be driven away was the enigma of all savage thought. Through an illogical philosophy, the origin of which is a long and strange story, he came to believe that diseases were living beings; that toothache is the pain wrought by the gnawing mythic worms; that the cough is caused by mythic insects; that headache is caused by invisible mythic ants; and that all diseases and all pains are produced by these mythic agencies. And he tried to drive them away by shrill shrieks, by mad howling, and by horrid imprecation. Then he sought to gain the aid of the friendly spirits of the world, — the good mythic beings. To him the rhythm of the dance and the chant was the language of joy. So he sought to woo these friendly spirits by using this language of joy; and, when wearied with his own efforts at driving away the maleficent spirits, he turned to the dance and the chant, and with them called for the beneficent spirits. In this manner the sylvan man came gradually to believe in the direct efficacy of dance and music as a medicinal agency. Dance and music are the quinine and calomel of the savage, — the “water-cure,” the “faith-cure,” the “blue-glass cure,” the “mind-cure,” the “Christian-science cure,” the “youth-restoring elixir,” the panacea for all human ills.

When the poor diseased people recovered, the joy of recovery became associated with music. The welcome to health and companionship which the poor invalid received was given in dance and music.

Sometimes storms came and destroyed their rude houses; sometimes drought came and destroyed their harvests; sometimes fierce winds came and congealed their life-fluids; sometimes mad lightning came, and, shivering the trees, ended their lives. And so by flood and wind and lightning, and many other agencies, they believed themselves to be persecuted by the spirits of the animal gods who must be appeased; and what would please the god so much as music and dancing? And so they danced to their gods, and beat their drums to their gods, and played their whistles to their gods, and blew their horns to their gods, until the winds stilled, and the storms abated, and the lightnings went out, and the thunders hushed, and the floods ran away to the sea; and then they rejoiced with feasting and dancing and music.

Before the sylvan man had learned to plant fields, and build storehouses, and provide for future days, he believed that every thing was the gift of his animal gods. The earliest provision that mankind made for the future was to lay up a store of their good will. And how could he gain their good will but by dancing and music? So at new moons and at new seasons he held festivals in honor of his gods, and gave them dancing and music.

When, in a later culture, man gathered the fruits of the forest and mead as a store for the winter day, and planted fields and gathered grains, he made thanksgiving to his gods in dancing and music.

The rallying cry to war was dancing and music. There is an instrument used by savages in many lands that consists of a simple tablet of wood, a hand's breadth in length and a finger's breadth in width, to which a short string is attached by one end, while the other is fixed to a stick like a cane. The performer, holding the stick in his hand, whips the tablet of wood through the air in such a manner that it makes a sound, sometimes quick but low, like the whiz of a bullet on the battle-field; sometimes shrill and loud, like the shriek of a cannon-ball thrown into a bombarded city. With these instruments a group of naked savage warriors, intent on plunder, rapine, and the midnight murder of men, women, and children, gather about the camp-fire in the weird dance, and leap and howl and whip their bull-roarers, until they work themselves into a state of fury.

It was in this manner that the music was freighted with emotion by the sylvan man when it was only rhythm, and when it was chained to the dance.

Some music expressed in rhythm and melody has had a long life among all the barbaric and civilized peoples of the world. Min-

strels have carried it about ; men have sung their songs in field and forest ; women have sung their songs at the oven and the loom ; boys have sung their songs while driving the herds to pasture, and girls while milking cows ; and there are songs for all times and all conditions and all peoples. Song has ever remained as folk-music, the delight of the people.

There are songs celebrating all passions, — all joys and all sorrows, all hopes and all fears, all loves and all hates. All the emotions of the human soul are coined into song. Song is the reservoir into which all human feelings are poured, and it is the fountain from which all human feelings may be drawn. And this is true not only in our language, but in all languages.

When harmony was given to music through its association with the drama, musical compositions were no longer confined to simple songs for the field, the fireside, and the chapel, but great pieces were composed for the temple and theatre, and music was made to express the emotions of religion and romance, as in the oratorio, cantata, and opera. This music bore on its wings the hope of heaven and the fear of hell. It told of the joy of the angels before the throne of God, and of the torments of demons in the presence of the Devil. The profane music of this period related biographies and histories filled with love and revenge, virtue and crime, courage and cowardice, repose and tragedy. Music in this stage is freighted with the feelings that are kindled and expressed by laughter and crying, by prattle and wrangling, by caresses and blows, by kisses and frowns, by praise and reproof, by plenty and poverty, by strength and weakness, by health and disease, by birth and death, by festivals and funerals, by carnivals and battles, by peace and war, by victory and defeat, by justice and injustice.

And now we must speak of the symphonic stage of music, when science has given it a multitude of sweet instruments.

The art of music was not born of the music of Nature : it was born of the pains and pleasures, the joys and sorrows, of mankind.

The appreciation of the beauties of nature is of slow growth ; and it is only in civilization, and with the most cultured people of civilization, that these beauties are sources of joy ; and it is only in the latest music that the highest intellectual pleasures are expressed. The beauties of the earth, the sea, and the air and the sublime spectacle of the heavens, are gradually being wrought into the emotional nature of mankind ; and the new music is informed with the strains that are played by Old Ocean against the shores of every land. It is filled with the anthem-music of the forest, and the songs of the birds that chorus the round earth with the rising sun.

In its late history new attributes have been added from the contemplation of nature. These are feelings kindled by the higher intellectual activities. The human reason has acquired a knowledge of the universe, and derived exalted emotions therefrom. The boundless sea now tells its story. From arctic and antarctic lands navies of icebergs forever sail, to be defeated and overwhelmed by the hot winds of the tropics. The lands with happy valleys and majestic mountains rise from the sea, built by the waves and fashioned by fire and storm. Over all rests the ambient air, moving gently in breezes, rushing madly in winds, and hurling its storms against the hills and mountains of the sea and the hills and mountains of the land.

The land, the sea, and the air are the home of a world of life, which man studies with ever-increasing interest and pleasure. The solid earth is composed of crystalline forms, and exhibits chemical activities which ever challenge admiration. Sound and heat, and light and electricity, and vitality and mentality, present modes of motion the contemplation of which fills the mind with delight. Looking above the earth, the worlds of the universe are presented to view, and their wonders fill the soul. So music has come to be the language of the emotions kindled by the glories of the universe.

Thus is seen the growth of music in four stages, — music as rhythm, music as melody, music as harmony, and music as symphony. Rhythm was born of the dance, melody was born of poet-

ry, harmony was born of drama, symphony was born of science. The motive of rhythmic music was biotic exaltation, the motive of melody was social exaltation, the motive of harmony was religious exaltation, the motive of symphony is æsthetic exaltation. It is thus seen that music develops from the emotional nature of man, as philosophy has its spring in the intellectual nature. The earliest emotions arose from the biotic constitution, — simple pleasure or pain, as felt in the body and expressed in rhythm : they were mere feelings. Then feelings were idealized, and became emotions, and were expressed in melody ; then the emotions were idealized, and became sentiments, and were expressed in harmony ; then the sentiments were idealized, and became intellectual conceptions of the beautiful, the true, and the good, and these were expressed in symphony.

Is there a new music for the future ? The science of music answers, "Yes." We know that music has been chained to "form," and imprisoned in the Bastille of musical intervals, and guarded by the henchmen of mathematical dogmas. But a few great musical composers, like Wagner, have broken the chains, and burst the bars, and killed the jailers, and they sing their liberty in strains of transcendent music.

When it is desired to cultivate skill in musical performance, it is necessary to cultivate the art in the individual in the same order in which it is cultivated in the race ; and he must first master rhythm, then melody, then harmony, then symphony. Then the love for music must be acquired in the same order. No one can love a symphony or an opera who does not first love song. If you would love the higher music, you must love the songs of the people ; and to affirm that you love a symphony, or an opera, or a cantata, but that you do not love a song, is like averring that you love a garden but do not love a rose, that you love a bouquet but care not for a lily : for a symphony is indeed but a bouquet of melodies, and an opera is a garden of many flowers.

Happy is the home that is filled with song, where boys and girls sing the melodies of the people, and where they make these melodies more musical with the violin, the piano, or the flute ; for to music is consigned the purest joy.

NOTES AND NEWS.

IN addition to the election of Dr. Weir Mitchell as president of the next Congress of American Physicians and Surgeons, to be held in September, 1891, which we have already noticed, Dr. W. H. Carmalt of New Haven was elected secretary ; Dr. J. S. Billings of Washington, treasurer ; Dr. William Pepper of Philadelphia, chairman of the executive committee ; and Dr. S. C. Busey of Washington, chairman of the local committee of arrangements. Dr. C. H. Mastin of Mobile is reported to have declined the presidency, on the ground that no member of the executive committee ought to be elected to the presidency.

— The fifty-eighth annual industrial exhibition of the American Institute of this city is now in progress at the Institute building, on Third Avenue, between Sixty-third and Sixty-fourth Streets. The building is well filled with tastefully arranged exhibits, covering a wide range of industries, several in which manufacturing processes are shown being especially attractive and interesting. The electrical exhibits are not as numerous as might be expected, there being only three electric-light companies and a few manufacturers of electrical instruments represented.

— In view of the reports which have recently been published respecting the Johns Hopkins University, President Gilman authorizes the statement that the university will begin its next year on the 1st of October with unimpaired efficiency. Neither the salary of the president nor those of the professors have been cut down, and several new appointments have been made. The indications during the summer have pointed to the usual number of students, and the courses of instruction will be given as announced in the programme. As to the finances of the university, it is no secret that the income derived from the Baltimore and Ohio Railroad was cut off some time ago ; but the accumulated income of former years, the income from investments outside of the railroad, the income from tuition (which amounted last year to nearly \$40,000), are available. Besides all this, a number of generous persons have

subscribed the sum of \$108,000, to be expended as an emergency fund during the next three years. In addition, a new building, given by Mr. Eugene Levering of Baltimore, is now going up. A lectureship in literature has been endowed by a gift of \$20,000. By the death of John W. McCoy the university inherits at once his choice library of 8,000 volumes, and is the residuary legatee of his estate. The exact amount to be received from this source cannot yet be ascertained, but the most prudent estimates place it above \$100,000, exclusive of the library. This gift is free from conditions. It is safe to say that within six months the Johns Hopkins University has received from these various sources nearly \$300,000, and other gifts are expected. The national character of the institution is a strong reason why its work should receive important aid from a distance. It will thus be seen that no consideration need be given to alarming rumors, as the present efficiency of the university is assured for the next three years.

— By the will of Mr. John W. McCoy, who died in Baltimore Aug. 20, 1889, the Johns Hopkins University is made the residuary legatee of his estate. His large and valuable library is also left to the university. His art collection is bequeathed to the Peabody Institute. A fuller statement as to this valuable gift will be subsequently made.

— President Hall of Clark University, Worcester, Mass., in an official statement, thus defines the functions of docent in the university: "The highest annual appointment is that of docent. This rank and title is primarily intended as an honor to be awarded to those worthy of more permanent and lucrative positions, as professors or assistant professors in colleges. It may be bestowed without examination upon a few men who have advanced beyond the requirements of a doctorate, and who satisfy the authorities of the university by a thesis, a public address, or in any other way, of both their scientific attainments and their teaching ability, and, if necessary, may be accompanied by a salary. Docents may be provided with individual rooms; and special apparatus may be purchased for their research if desired and approved. They may also be equipped and sent on scientific expeditions. While they will be expected during some part of the year to deliver a limited number of lectures on some special chapter of their department, their time will usually be reserved for study and research in a way best adapted to qualify them still more fully for academic advancement. It is believed that by the existence of such a select body of men of guaranteed scientific training, ability, and approved power to teach, the difficulties under which college trustees sometimes succumb in selecting suitable men for the professors may be diminished, and that otherwise this new academic grade will aid in raising standards of scholarship in colleges, and encouraging scientific research." The work of the university has begun. The professors and instructors in the departments of mathematics, physics, chemistry, biology, and psychology met their students Monday, Oct. 7. The following lectures were delivered: by Dr. Bolza, in mathematics, Oct. 8; by Dr. Cook, in psychology, Oct. 7; by Dr. Sanford, in psychology, Oct. 8. Dr. Donaldson gave an introductory lecture on Oct. 9 in the neurological laboratory.

— In the *Michigan Engineers' Annual*, which is the report of the proceedings of the Michigan Engineering Society, of January, 1889, Professor M. E. Cooley, M.E., of Ann Arbor, gives the following experience on the value of covering steam-pipes: "The benefits of covering steam-pipes to prevent radiation are strikingly illustrated by the following example: The Thomson-Houston electric-light plant in Ann Arbor has about 60 feet of 7-inch pipe, connecting the boiler with the engines, and two large steam-drums above the boilers. In March, 1887, the steam at the far end of this pipe was tested to determine the amount of entrained water, the pipes and drums at the time being uncovered. An average of nine experiments gave 31.01 per cent of moisture. In June of the same year, after the pipes were covered with magnesia sectional coverings, the quality of the steam was again tested, the average of five experiments giving 3.61 per cent moisture. The tests were made by the same men, from the same connections, and in the same manner. The pipes and steam-drums in March were subjected to a draught, which, of course, aided the condensation. Enough water passed into the cylinders to retard the engines, producing a disagreeable

noise. In June the weather was warmer, and the pipes and steam-drums were well protected. The quality of steam at the boilers was tested in June, and showed about 3 per cent of moisture. Assuming that 100 indicated horse-power were being developed at the time, and that each horse-power required 30 pounds of steam per hour, we would need 3,000 pounds of steam. If the steam is assumed to have 25 per cent entrained water, due to condensation in the pipes and connections, then 4,000 pounds steam will need to be produced in the boilers, or 1,000 pounds more than necessary. To produce this steam will require about 125 pounds of good coal per hour, or 1,000 pounds per day of eight hours. One-half ton per day, at \$3 per ton, for 300 days, equals \$450, which, at 6 per cent, pays the interest on \$7,500. The actual cost of the covering, put on complete, probably did not exceed \$150.

— The deepest bore-hole in the world, claimed at different times for a number of places, is, according to latest accounts, at Schladebach, a small German village near Leipzig. It measures 1,748.4 metres, or about 5,735 feet. The time expended in boring to this depth amounted to six years, at a cost of \$52,500. A peculiar experience encountered in connection with this and other deep holes in different parts of Germany is, according to *Uhland's Wochenschrift*, that the observed temperatures, while steadily increasing with the depths, show a smaller ratio of increase in the lower strata.

— In a recent issue of the *Centralblatt der Bauverwaltung*, attention is directed to the fact, observed in some of the streets of Frankfort-on-the-Main, Germany, that the asphalt pavement in the immediate neighborhood of large gas mains is rapidly destroyed by escaping gas, deep cracks being formed. This has been found to be particularly marked at places where the underlying layer of beton was imperfect, due to interruption of the work over night while laying. If this is true, it furnishes an additional reason for preventing that escape of gas from the mains in New York City which has already given so much trouble by explosions in subways and sewers.

— How many of the engineering works of the nineteenth century will there be in existence in the year 6000? Very few, it is feared, and still less those that will continue in the far-off age to serve a useful purpose. Yet there is at least one great undertaking conceived and executed by an engineer, which, during the space of four thousand years, has never ceased its office, on which the life of a fertile province absolutely depends to-day. We refer to the Bahr Joussuf, — the canal of Joseph, — built, according to tradition, by the son of Jacob, and which constitutes not the least of the many blessings he conferred on Egypt during the years of his prosperous rule. This canal took its rise, as given in *Engineering*, from the Nile at Asiut, and ran nearly parallel with it for nearly two hundred and fifty miles, creeping along under the western cliffs of the Nile valley, with many a bend and winding, until at length it gained an eminence, as compared with the river-bed, which enabled it to turn westward through a narrow pass, and enter a district which was otherwise shut off from the fertilizing floods on which all vegetation in Egypt depends. The northern end stood seventeen feet higher than low Nile, while at the southern end it was at an equal elevation with the river. Through this cut ran a perennial stream, which watered a province named the Fayoum, endowing it with fertility and supporting a large population. In the time of the annual flood a great part of the canal was under water, and then the river's current would rush in a more direct course into the pass, carrying with it the rich silt which takes the place of manure, and keeps the soil in a state of constant productivity. And this, with the exception of the tradition that Joseph built it, can be verified to-day, and it is not mere supposition or rumor. Until eight years ago, it was firmly believed that the design has always been limited to an irrigation scheme larger, no doubt, than that now in operation, as shown by the traces of abandoned canals and by the slow aggregation of waste-water which had accumulated in the Birket el Querun, but still essentially the same in character. Many accounts have been written by Greek and Roman historians, such as Herodotus, Strabo, Mutianus, and Pliny, and repeated in monkish legends or portrayed on the maps of the middle ages, which agreed with the folk-lore of the district.

These tales explained that the canal dug by the ancient Israelite served to carry the surplus water of the Nile into an extensive lake lying south of the Fayoum, and so large that it not only modified the climate, tempering the arid winds of the desert, and converting them into the balmy airs which nourished the vines and the olives into a fulness and fragrance unknown in any part of the country, but also added to the food-supply of the land such immense quantities of fish that the royal prerogative of the right of piscary at the great weir was valued at \$250,000 annually. This lake was said to be four hundred and fifty miles round, and to be navigated by a fleet of vessels, while the whole circumference was the scene of industry and prosperity.

— A company is now putting down a shaft into Grand Avenue Cave, four miles from Mammoth Cave, for the purpose of bringing up the air and putting it into the rooms of a large hotel which they propose to build, both as a pleasure-resort and sanitarium. They have been able to get no information on the subject, and ask for such in the "Want" column in this number.

— The Shore Line Railway bridge at New London, the largest swing-span drawbridge in the world, is now in position. It was built parallel to the shore along the fender pier, so as not to obstruct navigation, and was swung into place half an hour before sunset Saturday, Sept. 28. It is of solid steel, weighs nearly 2,500,000 pounds, and its connecting parts, when the bridge was swung into position, shot into the mortises of the bridge proper with absolute precision. This was a great relief for the anxious engineers. Some of the highest engineering skill ever employed in bridge-building has been used in the construction of this bridge, the situation involving peculiar difficulties. In some places, says *The Iron Age*, 56 feet of water and 80 feet of mud were found where the piers must be set. There great timber curbs were constructed, and sunk to the total depth of 137 feet. After scooping out the interior mud, the curbs were driven full of piles. These, cut off at a level midway in the curbs, were bound solidly together by filling the spaces with concrete. On this rock-like basis the masonry of the pier was built up. The centre pier is an immense structure 71 feet square. It is flanked on either side by spans of 310 feet, and there are two other spans at either side of the river of 150 feet each. The unusual length of draw was required by the United States Government, that there should be no obstruction to the passage of the naval fleet to the Thames naval station farther up the river. This great bridge, 1,422 feet long, crosses the Pequod River (imitatively named by the first settlers the Thames, while they quite as foolishly named Pequod New London) from a point at the terminus of the Yale-Harvard regatta course at Winthrop's Point, at the upper part of the town.

— According to *Nature*, the International Oriental Congress, which was held this year during the first and second weeks of last month in Stockholm and Christiania, was well attended, and was especially noticeable for the enlightened and warm interest taken in the proceedings by the King. Representatives of Oriental learning from the chief countries were his Majesty's personal guests, the members of the congress present were on several occasions specially entertained by him, and in other marked ways the King showed his desire to honor science and learning in the persons of the assembled Oriental scholars. The *Times* is the only one of the English daily papers in which the proceedings have been followed regularly; and in the last letter on the subject, its correspondent, who has been far from a prophet of smooth things in reference to all the proceedings, says that "this eighth International Oriental Congress was favored above all its predecessors by the right royal splendor with which the ruler of the two countries entertained his guests, by the warm interest which the citizens took in the foreign *savants*, by the care and kindly forethought with which all the arrangements for our comfort had been planned and were carried out, and last (not least) by the grand and lovely natural features of the places which the members visited. Perhaps at future congresses care will be taken that there be less of empty Oriental parade, by which no palpable literary object can be gained, and that greater facilities be given for placing without delay within the reach of members an abstract of the proceedings

in each section. However, in the face of such boundless hospitality and such personal sacrifices on the part of our hosts, it would be ungracious were we to take exception to what are, after all, but small matters of detail." A large number of papers of great philological and general interest were read, as will be readily gathered from the following list of the sections, with their respective presidents and vice-presidents: — Section I. Modern Semitic: presidents, Baron Kremer of Vienna, M. Schefer of Paris, M. de Goeje of Leyden. Section II. Ancient Semitic: president, M. Fehr of Stockholm; vice-presidents, M. Chivolson of St. Petersburg, M. Oppert of Paris. Section III.: presidents, M. Max Müller of Oxford, M. Weber of Berlin, M. Spiegel of Erlangen. Section IV.: president, Brugsch Pacha; vice presidents, M. Lieblein, M. Reinsch. Section V.: president, M. Schlegel of Leyden; vice-president, M. Cordier of Paris. Section VI.: president, M. Kern of Leyden; vice-president, Mr. R. N. Cust of London.

— The carrier-pigeon has just been turned to a curious use in Russia, according to the *Novoe Vremya*. It is to convey negatives of photographs taken in a balloon. The first experiment was made from the cupola of the Cathedral of Isaac, and the subject photographed was the Winter Palace. The plates were packed in envelopes impenetrable to the light, and then tied to the feet of the pigeons, who safely and quickly carried them to the station at Volkovo.

— From the general results of the Swiss census of Dec. 1, 1888, which have already been worked out, it seems that the total population is 2,934,055, against 2,846,102 in 1880. The German-speaking element increased from 2,030,792 in 1880 to 2,092,562, which, taking into account the normal growth of the population, was no relative increase, the proportion in both cases being precisely 71.3 per cent of the whole. The French, on the other hand, increased from 608,007 to 637,940, which was also a relative increase of 21.4 to 21.7 per cent; while the Italian declined actually as well as relatively, the numbers being 161,923 in 1880, and 156,602 in 1888, or 5.7 and 5.3 per cent respectively. The decline of the Italians in the cantons of Uri and Schwyz is explained by the return home of a large number of Italian workmen engaged in the St. Gothard Railway; but it is not so easy to explain why there is a large decrease in the Germans in the cantons of Berne and Neuchâtel, while the French have increased. In general the French increase in Switzerland seems to be at the expense of the Germans, while the German element recovers its place at the expense of the Italian.

— Among recent appointments of Johns Hopkins men, we note the following: Edward A. Bechtel (A.B., 1888), professor of Greek in Mount Morris College, Illinois; Edward W. Bemis (Ph.D., 1885), adjunct professor of history and economics in Vanderbilt University; B. Meade Bolton (assistant, 1887-88), director of the Department of Bacteriology in the Hoagland Laboratory, Brooklyn, N.Y.; David T. Day (Ph.D., 1884), expert and special agent in charge of the subject of mines and mining for the eleventh census; John C. Fields (Ph.D., 1887), professor of mathematics, Allegheny College, Pennsylvania; Andrew Fossum (Ph.D., 1887), classical instructor, Hill School, Pottstown, Penn.; J. Edward Harry (Ph.D., 1889), professor of Greek and German in Georgetown College, Kentucky; George L. Hendrickson (A.B., 1887), professor of Latin in Colorado College; George N. C. Henschen (A.B., 1889), instructor in natural sciences in the Reading (Penn.) High School; William H. Howell (Ph.D., 1884, and associate professor), lecturer on physiology in the University of Michigan; Frank G. Hubbard (Ph.D., 1887), instructor in English in the University of California; Cary T. Hutchinson (Ph.D., 1889), docent in physics in Clark University; James T. Lees (Ph.D., 1889), principal of the Latin School, and instructor in Latin and Greek in the University of Nebraska; Henry Sewall (Ph.D., 1879, and recently professor in the University of Michigan), professor of physiology in the College of Physicians and Surgeons, Baltimore; Moses S. Slaughter (fellow, 1885-86), professor of Latin in Iowa College; Professor Albion W. Small (Ph.D., 1889), president of Colby University, Maine; William E. Story (associate and associate professor, 1876-89), professor of mathematics in Clark University; James S. Trueman (fellow, 1888-89), professor of Greek and Latin in Allegheny College, Pennsylvania.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The "Exchange" column is likewise open.

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CONTENTS:

ELECTRICITY IN MINING..... 243	Parasites of the Blood..... 254
EVOLUTION OF MUSIC FROM DANCE TO SYMPHONY <i>J. W. Powell</i> 244	Execution by Electricity..... 254
NOTES AND NEWS..... 249	BOOK-REVIEWS.
EDITORIAL..... 252	Strength: How to get Strong and keep Strong..... 254
The New President of Columbia.— The Prospect of having a World's Fair in New York.	The Reconstruction of Europe..... 254
MENTAL SCIENCE.	AMONG THE PUBLISHERS..... 255
New Experiments upon the Time- Relations of Mental Processes.... 252	LETTERS TO THE EDITOR.
HEALTH MATTERS.	Lightning-Strokes <i>H. A. Hazen</i> 257
The Effects of Alcohol upon Lon- gevity..... 254	A Queer Maple-Tree <i>M. G. Manting</i> 257
The Food Treatment for Insomnia. 254	INDUSTRIAL NOTES.
	Electric Blasting Battery..... 258
	An Electric Boat on the Housa- tonic..... 258

MR. SETH LOW, ex-mayor of Brooklyn, has been elected president of Columbia College, to fill the vacancy caused by the death of Dr. F. A. P. Barnard. President Low is an alumnus of the college of which he has just been made the head. He is a native of Brooklyn, and as mayor of that city attained a national fame. The general verdict is that the trustees have done well in selecting a man who has always shown himself equal to the positions of trust in which he has been placed, who is in the very prime of life, being about forty years old, and who has the due scholarly training for his new work.

THE WORLD'S-FAIR FINANCE COMMITTEE met Oct. 8, and received the report of their executive committee. The report of the executive committee was discussed, but not acted upon. After careful examination of the whole subject, the committee report that in their opinion no complete financial scheme can be determined upon until it is approximately known what is the aggregate amount of money to be raised; and this will be largely an open question until the site, plan, and scope of the exhibition are finally agreed upon. It is of first importance that Congress should give to the exhibition a national and an international character by appropriate legal enactment, which should, at the same time, determine its location in this the principal port of entry and metropolis of the country. It is also essential that the exhibition should receive encour-

agement and assistance from the State and city of New York; and the suitableness and liberality of this assistance must be an important factor in any financial plan which may be adopted, for if direct money contributions are voted, or lands are set apart for the use of the exhibition which belong to or may be acquired by the city, and upon which it may lawfully erect buildings, a very much less sum will be needed than if the committee must raise all the money, or if private property must be leased or purchased. Meanwhile, to show the sincerity and willingness of the citizens of New York, they recommend that steps be taken to raise a preliminary fund of \$5,000,000, for which stock should be issued, when authorized by congressional or legislative enactment.

The meeting of the world's-fair committee on site on the same day was largely attended. The chief business was the consideration of a report from the sub-committee on buildings, consisting of Messrs. Towne, Chandler, and Hunt, who were appointed specifically to ascertain in regard to the value of property within the boundaries of the proposed site. In substance the report said that the site should be ample for the construction of five buildings, to cover in the aggregate 65 acres, and 200 smaller buildings, to be scattered over an area not to exceed 250 acres. In regard to the area of the main site, the committee reported that the exposition could be held at Riverside and Morningside Parks and on adjacent private lands, of which there might be needed only 120 acres, but that it could be better accommodated in 200 acres, making the total area of the site from 200 to 270 acres. From all the inquiries that the committee had been able to make, the price of property in that section of the city was about \$100,000 per acre, involving an outlay of \$12,000,000 or \$20,000,000, according to the choice of 120 or 200 acres. When the various amendments had been voted on, the resolution, which was passed unanimously, read as follows: "That the proposed site, which includes Riverside and Morningside Parks, shall be held to comprise such portions of Central Park north of Ninety-seventh Street as are physically available and may be found absolutely necessary for the purposes of the exposition, and also to include adjacent lands fronting on the north and east of Central Park, is in all respects the best; that therefore all efforts should be concentrated upon the acquisition of the needed area in this locality."

MENTAL SCIENCE.

New Experiments upon the Time-Relations of Mental Processes.

WITH the law once admitted that all mental states are definitely related to and conditioned upon physical ones; it would readily follow that mental processes, or at least the physical changes that accompany them, take a definite amount of time for their normal performance. Furthermore, these times can be regarded as an index of the complexity of the act in question; and a comparison of the times taken up by various mental processes will furnish a basis for their classification, and may afford desirable glimpses of the nature of the processes themselves. This is the cardinal thought that has urged investigators to carefully measure those simple acts that lie at the basis of psychic life with all the accuracy that the use of refined and complicated apparatus could furnish. A great many interesting results were obtained, and many theories refuted. Recently the fact has come into prominence that the attitude of the subject, the direction of his attention, exercises a profound influence upon the results, and many observations have been repeated with this fact in mind. Among these the work of Dr. Münsterberg ("Beiträge zur Experimentellen Psychologie," Heft 1, 1889), of the University of Freiburg, merits detailed notice.

As re-actions were to be made by each of the five fingers of the right hand, many preliminary experiments were made with each to eliminate the difference in alertness of the fingers. The fingers pressed down upon the keys of a keyboard, and as soon as a sound (usually a word) was heard the re-action was made by raising the appropriate finger. In this simplest process of executing a move-

ment as soon as an expected sensation has been received, Lange had found a great and constant difference according as the attention was fixed upon the sensation, the expected sound, or upon the movement of re-action. In the first case the subject distinctly waits for the sensation, appreciates it, and then proceeds to move the finger: it is a "sensory" re-action. In the second case the impression is taken in almost automatically, and the desire is to have the finger move the moment any impression is felt: it is a "motor" re-action. The sensory is always longer than the motor re-action. Lange found in three observers sensory times of .230, .223, and .224 of a second; and motor times of .123, .125, and .137 of a second, — an average difference of one-tenth of a second.

I. Münsterberg's sensory time is .162, his motor .120, of a second, — a much smaller difference of only .042 of a second. It is to be noted that the motor times of all the observers agree remarkably well, while their sensory times show individual variations. The explanation of these facts will be attempted after the results of certain other experiments have been given.

II. The next complication consisted in calling out in an arbitrary order "one," "two," "three," "four," or "five," to which the thumb, forefinger, middle finger, ring-finger, and little finger were to respond respectively. This is more complicated, and involves the association of "one" with a movement of the thumb; and so on. As before, one may fix the attention upon the expected sound or upon the movement. The sensory time for the entire process was .383 of a second; the motor, .289 of a second, — a difference of .094 of a second. When making a sensory re-action, the sound is always appreciated; and errors, i.e., raising the wrong finger, never occur. In motor re-actions they occasionally occur, the error invariably consisting in raising a neighboring finger.

III. Here the re-action was the same; but, instead of the words "one," "two," "three," "four," "five," the Latin declension — *lupus, lupi, lupo, lupum, lupo* — was associated with the five fingers, the process being the same as before, but the association more artificial. The result was, for sensory re-actions, .465 of a second; for motor, .355 of a second, — a difference of .110 of a second. Only a single false re-action was made.

IV. The movements of the five fingers were associated respectively with the five members of the three following declensions of German pronouns: *ich, meiner, mir, mich, wir; du, deiner, dir, dich, ihr; der, des, dem, den, die*. This is more complex not only by the change between three series, but by the relatively minute and irregular distinctions between the words. The sensory time was .688 of a second; the motor, .430 of a second, — a difference of .258 of a second. Here errors occurred in the motor re-actions ten per cent of the time, showing the increased facility of confusion. It was noticed, too, that the second finger was often erroneously raised in answer to *du*, apparently on account of its position in the familiar series *ich, du, er*.

V. Here the elements of the process are changed. If a noun is called, the thumb is to be raised; if an adjective, the forefinger; if a pronoun, the middle finger; if a number, the ring-finger; if a verb, the little finger. This very artificial relation was first thoroughly learned by going over the list, raising each finger as the class to which it corresponded was mentioned. All the words were monosyllables, and new words were being constantly used, no word occurring twice. The sensory time was .712 of a second; the motor, .432 of a second, — a difference of .280 of a second. Here errors are very frequent (thirty per cent), but are confined to the motor re-actions.

VI. This series was just like the former except that the categories were "a city," "a river," "an animal," "a plant," "an element;" such as "London," "Rhine," "dog," "rose," "gold." The sensory time was .893 of a second; the motor, .432, — a difference of .461 of a second. Errors occurred in twelve per cent of the motor re-actions.

VII. Here the categories were still more difficult; viz., "an author," "a musician," "a naturalist," "a philosopher," "a statesman or general." Only in a few very prominent cases is this decision easy. The average time was, for sensory re-actions, 1.122 seconds; for motor, .437 of a second, — a difference of .685 of a second. Errors occurred in twenty-five per cent of the (motor) re-actions.

It is to be noted that the cases I., II., and III. involve associations of a finger-movement with but one word: it is an "anticipated" association. In the other cases a more or less wide range of words is to be re-acted upon by the same movement: it is a "free" association. It will have been noticed, too, at what a rapid rate the difference between sensory and motor times increases as the processes become more complex, this difference being sixteen times as great in VII. as in I.

The explanation of the shortening of the re-action time by the motor form of re-action is comparatively simple in Case I. We need only assume, quite naturally, that the fixation of the attention upon the movement really gets ready the innervation (as it were, lights the match beforehand), and is thus immediately ready to make the movement (to set afire the train of powder). But in the following cases not only does this explanation become doubtful (for, inasmuch as it is not known which finger is to be moved, only a general, unspecialized innervation to move a finger can be anticipated), but it can only account for .042 of a second of difference, while the real difference progressively rises to sixteen times that amount. We can be quite sure, then, that the shortening takes place in the purely mental process of recognizing a given word as an instance of a more or less general class, and of appreciating that this class is to be represented by a certain movement. While in the four last cases the sensory times rose from .688 to .712, to .893, to 1.122 seconds, the motor time practically remained unchanged, — .430, .432, .432, and .437 of a second. The increase in the sensory time indicates that the processes are becoming mentally more complex. It is more difficult to recognize that a given word (heard only once during the experiments) is a certain part of speech than to recognize a word as one of the same three, *ich, du, der*, or *meiner, deiner, des*, and so on; still more difficult to recognize a concept as belonging to one of five well-known general categories; and most difficult to place a man in one of five special, somewhat closely related professions. But why should these differences disappear by simply fixing the attention upon the movement to be executed? Indeed, according to a current theory, of which Wundt is the acknowledged champion, and which Dr. Münsterberg fiercely combats, turning the attention towards an act shortens the time of its accomplishment; fixing the attention upon the mental, sensory part of the process should shorten the time. This apperception theory, that conceives the mind as a point in which only a single act has room at a given moment, and through which accordingly the several elements of a complicated process must pass *seriatim*, gives no satisfactory explanation. Dr. Münsterberg regards the true explanation to lie in the fact that in the motor re-actions the several parts of the mental process overlap in time. In the motor re-action we have before us, as it were, five possible movements, each (aided, perhaps, by unconscious tentative movements) ready to be made, and five lines of association along one of which the impulse is coming. The moment the word is sounded, it is referred to the "third-finger-moving category," or whichever it may be, — the intermediate acts of recognizing, let us say, that the word was "frog," that a frog is an animal (and not one of the other four classes), and that when an animal's name is called we must raise the third finger; which acts are gone through consciously and successively, in the sensory re-action being performed almost simultaneously and automatically, or at least subconsciously. This, in Cases IV., V., VI., and VII., would be about the same process, the tracts of association (cortical fibre-connections to concretize the conception) being about equally much used in each case, since their entire use was that brought about by the experiments themselves. We see, too, why it is natural that in the sensory cases errors did not arise, but that in the motor re-action an impulse could readily be switched into a neighboring association-tract. Dr. Münsterberg regards the motor form of re-action as the one more closely corresponding to natural, every-day processes; the sensory re-action being a mere artificial, experimental result. When we act and speak, the movement results before we have consciously appreciated the excitation, analyzed it, and referred it to certain categories. It seems to be referred to certain definitely established trains of thought, the reasons for doing so never consciously appearing.

While this explanation is not entirely adequate, it has the advan-

tage of giving a very real interest to the facts, of being in harmony with current psychophysical and neurological conceptions, and of suggesting further experimental inquiry by the results of which it can be substantiated or refuted.

A point unnoticed in the original essay may be here appended. If we compare the gradual increase in the motor times from I. to VII., we find the greatest difference (.169 of a second) in passing from I. to II.; that is, when, instead of re-acting by one certain motion, we re-act according to circumstances by any one of five, — an evident increase of motor complexity. Next, in passing from II. to III., we find a smaller increase of .066 of a second easily explicable by reflecting that we have already had practice in considering the fingers as "one," "two," "three," "four," "five;" and so the connections are easier, while the associations with *lupus*, etc., are new. In passing from III. to IV. we have an additional motor complexity in the fact that each of the association tracts is subdivided into three sub-tracts, and the expectation of the intended movement is accordingly less definite. The time increases by .075 of a second. When these tracts become divisible into an indefinite number of strands, it does not seem to complicate matters, and from here on the motor times are the same. A similar comparison of the increase of sensory times and of the percentage of error will be equally instructive.

An account of further experiments by Dr. Münsterberg will be given in a future number of *Science*.

HEALTH MATTERS.

THE EFFECTS OF ALCOHOL UPON LONGEVITY. — The British Medical Association appointed a commission to inquire and ascertain the average age of three classes of drinkers; to wit, total abstainers from alcoholic beverages, moderate drinkers, and sots. The commission reported its observations upon 4,234 deaths, divided into five categories: 1. Total abstainers; 2. Habitual, temperate drinkers, — those who consume a moderate amount of alcoholic liquors; 3. Careless drinkers, — those who do not mean to get drunk, but are simply imprudent drinkers; 4. Free and habitual drinkers; 5. Decidedly intemperate drinkers, — sots. According to this classification, the average age reached by each of these categories is as follows: first class, 51 years 22 days; second, 63 years 13 days; third, 59 years 67 days; fourth, 57 years 59 days; fifth, 53 years 3 days. From this the curious fact is brought out that the teetotalers are the shortest lived, the sots having but a slight advantage over them in the average duration of life. The moderate drinkers reach the most advanced age.

THE FOOD TREATMENT FOR INSOMNIA. — Dr. Eggleston says, in the *Journal of the American Medical Association*, that most students and women who are troubled with insomnia are dyspeptic, and he has found it easy to successfully treat such cases without medicine. They are instructed to eat before going to bed, having put aside work entirely at least an hour before. If they are not hungry, they should simply be instructed to eat; and if they are hungry, they should eat whatever they want. A glass of milk and a biscuit is sometimes all that can be taken at first, or a mashed potato buttered. In a short time the night appetite will grow, and the appetite will then need no particular directions. If possible, the night meal should be taken in another room than the sleeping-apartment, and for men in the city it will be found advantageous to go out to a restaurant. The idea of going out for something to eat, and having to wait a short time for it, will excite the appetite. Before eating, however, a bath should be taken, preferably cold or cool, which should be given with a sponge or stiff brush, and the body thoroughly rubbed off with a coarse towel afterward. The bath need not be more than five minutes in duration. After the bathing and rubbing, or after eating, a moderate amount of exercise should be taken. For this a few minutes with Indian clubs or dumb-bells is sufficient. Further than this, the patient should go to bed at the same hour every night, and arise at the same hour every morning. There is a popular superstition that grown people should not eat immediately before going to sleep; that it will give them indigestion or nightmare, or both. Dr. Eggleston cannot see why adults should be so very different in this respect from babies. It may be true that digestion is carried on slowly during sleep, and

that the digestive function is less active, but here one need not be in a hurry for the completion of the operation. The average person should be in bed seven or eight hours, which is time enough for the digestion of almost any thing edible. In our American life he thinks, the digestion carried on through sleep probably has the better chance for thoroughness.

PARASITES OF THE BLOOD. — A Russian scientific observer some years since discovered in the blood of birds animate bodies of the nature of parasites, to which he has given the name of *Polimitus*, presenting a striking resemblance to the organisms described by M. Laveran as existing in the blood of persons attacked by malarial fever. Subsequent researches have shown that the presence of microbial parasites of animal origin in the blood is much more common than had been suspected, more especially in cold-blooded animals. Of warm-blooded animals, carnivora are more liable to be invaded by these intruders than others; but it is comforting to learn, that, for the most part, their presence does not appear to entail any particular inconvenience. According to *The Medical Press*, only four or five out of three hundred birds examined died in consequence of lesions caused by the parasites, and the pathological appearances were then identical with those observed in the subjects of malarial fever.

EXECUTION BY ELECTRICITY. — At a recent meeting of the Paris Academy of Sciences a communication from Mr. Edison was read respecting the use of electricity as a means of inflicting capital punishment. He is of opinion that an alternative current will cause death without pain, but he adduces no experimental evidence in support of that contention. The matter was referred to the medical section of the Academy, which is to have the assistance of M. Marcel Desprez, the electrician, in drawing up a report on the subject.

BOOK-REVIEWS.

Strength: How to get Strong and keep Strong, with Chapters on Rowing and Swimming, Fat, Age, and the Waist. By RICHARD A. PROCTOR. London and New York, Longmans, Green, & Co. 12°. 75 cents.

HERE is a somewhat lengthy title, and one recalling those of a hundred years ago, when in the titlepage were generally revealed the author's tenets, be they in religion or the sciences. Mr. Proctor defines the strength to which he refers as that which it is well that all actively employed members of the human family should have. The average man or woman is so engrossed in his struggle for existence, that he has no time and energy to give to keeping his body in good working order in all its parts. It may be that it works well enough under ordinary circumstances, but after a few years of inattention any effort at unusual exertion reveals a softened muscle here, or a stiff joint there, that had not been suspected. How by a due but not excessive amount of exercise to find these weakening parts, and to bring them back to healthful vigor, is one of the author's objects.

But in the chapters on reducing fat, on nature's waist and fashion, on learning to swim, and on other cognate subjects, are to be found some good advice, and some suggestions likely to prove fruitful of discussion.

The Reconstruction of Europe. By HAROLD MURDOCK. New York, Houghton, Mifflin, & Co. 12°. \$2.

THIS work is an account of leading political events in Europe from the establishment of Louis Napoleon's empire in 1850 to the close of the Franco-German war in 1871. The introduction by John Fiske gives a general survey of the great political movements of the century, and Mr. Murdock then takes up his theme at the downfall of the French republic of 1848, and the defeat of the other revolutionary attempts of that time. Attention is given almost exclusively to international affairs, and both diplomatic and military manœuvres are described at length. The work is well written, though sometimes with little too keen an eye to dramatic effect, and with less philosophical insight than might have been wished. Too much space is given to unimportant military details to the exclusion of political events of much greater consequence, a fault that is specially noticeable in the earlier chapters. Moreover, we do

not see the propriety of including the Crimean war in the subjects treated; for, though it occurred after the time at which Mr. Murdock begins his narrative, it had nothing to do with the reconstruction of Europe, and its connection with the later events described is very remote. Of course, the greater part of the volume is devoted to the unification of Italy and Germany, and the author shows pretty clearly why the revolutionists of 1848 failed to reach these ends, and why and how they were afterwards attained. The diplomacy of Cavour and Bismarck is well described, while the obtuseness of the French Emperor and his ministers and marshals is strikingly shown. Some of the great battles of the epoch, especially that of Sadowa and the engagements around Metz, are very clearly delineated, and those who are fond of military history will find many interesting chapters in Mr. Murdock's book. He closes without alluding to the Russo-Turkish war of 1878, doubtless because the work of reconstruction in that quarter is not yet completed, and no one can tell how it will end. On the whole, and in spite of some drawbacks, Mr. Murdock has written an interesting work, and one that will be specially useful to those persons who wish to keep informed of the general course of European affairs without going into all the details.

AMONG THE PUBLISHERS.

ARNOLD & Co., Philadelphia, publish this week Mrs. S. T. Rorer's book on "Home Candy-Making."

— Among the scientific notes in the *Johns Hopkins University Circulars* for September are "Contributions to the Mineralogy of Maryland," by George H. Williams; "Note on some Minerals from the Chrome-Pits of Montgomery County, Md.," by A. C. Gill; "A Study of the Oyster-Beds of Long Island Sound with Reference to the Ravages of Starfish," by C. F. Hodge; and "Association in Substitution and Rotation," by Professor Morton W. Easton of the University of Pennsylvania.

— *The Publishers' Weekly* notes the promotion of one of the most popular and promising members of the trade. Mr. Edward W. Bok last week resigned his position as manager of the advertising department of Charles Scribner's Sons, to assume the editorship of *The Ladies' Home Journal* of Philadelphia, under most favorable arrangements. Mr. Bok has been with the Scribners for five years, and in graduating to the editorial chair becomes, perhaps, the youngest chief editor in the country. He is twenty-five years of age. In this connection, the following extract from the New York *Star* possesses special interest at this time: "Only those on the 'inside' of New York literary and journalistic circles know any thing about 'The Bok Syndicate Press,' a bureau from which emanate many of the best and most striking literary articles by famous authors found in the modern newspaper. It is owned and managed by two brothers, Edward W. and William J. Bok. The combined ages of these two young publishers do not make the figure fifty, and yet within their control rests one of the most remarkable literary influences of to-day. They control the literary work of some forty-five of the most famous men and women of the day, which they supply to newspapers simultaneously all over this country and in Canada and England. Edward Bok holds a responsible position in one of the big New York publishing-houses, and his name is withheld from the enterprise. William devotes all his time to the work, and under his name the business is conducted. While Edward makes all the contracts with authors, William stands at the helm and carries out the ideas of his younger brother. A better matched couple of brothers it would be difficult to find. Edward has a wonderfully extensive acquaintance among famous people. He is well read, has good literary judgment, and knows precisely what the people want. William is of untiring energy, and a doubtful literary venture becomes a success in his hands. The brothers are very popular in society, and one is almost sure to meet them at any prominent literary or social event. Both are good talkers, have pleasant manners, and what the one lacks the other supplies. They have built up their business from nothing. Henry Ward Beecher started Edward by making him his literary manager, and in this way the bureau began. Now almost every author of note writes for the two brothers. They have no difficulty in securing writers, for they pay promptly and

manage excellently. Their principal writers include Grace Greenwood, Wilkie Collins, Marion Harland, Lew Wallace, Ella Wheeler, Will Carleton, Max O'Rell, and a score of others. They work quietly, the general public hears but little of them, yet it is doubtful whether any two young men in New York have so bright a future before them."

— Brentano's will publish shortly a collection of papers on technical and historical subjects under the title of "Military Miscellanies," by Gen. J. B. Fry, U.S.A.

— Roberts Brothers have just ready "Louisa M. Alcott: her Life, Letters, and Journals," edited by Ednah D. Cheney, illustrated with portraits and a view of the Alcott house in Concord.

— Houghton, Mifflin, & Co. published on the 5th "A Summer Journey to Alaska," by Maturin M. Ballou, who describes in a most interesting manner not only the resources and features of the country and people of Alaska, but also the wonders of the Yellowstone Park and the marvellous country along the Canadian Pacific Railway; "The Reconstruction of Europe," a sketch of the diplomatic and military history of continental Europe, from the rise to the fall of the second empire, by Harold Murdock, with an introduction by John Fiske; also the first two volumes of the scientific papers of Asa Gray, selected by Charles Sprague Sargent, comprising reviews of works on botany and related subjects, 1834-87, and essays and biographical sketches, 1841-86. They publish this week the pretty two-volume edition of the "Autocrat of the Breakfast-Table." It is promised in beautiful type, tasteful binding, and with steel-engraved titlepages. Miss Lucia T. Ames's novel, "Memoirs of a Millionaire," comes very opportunely, when the public is engaged as never before in thinking on social questions; and her story, which suggests some excellent uses for wealth, is likely to find eager readers. Rev. Julius H. Ward's little book, "The Church in Modern Society," is an attempt to show what influence the Church is entitled to exert, why it fails now to exert it, and how it may regain its lost prerogative. The new edition of the *Atlantic* index, affording ready access to the varied riches of the sixty-two volumes of the *Atlantic Monthly*, will be welcome to many.

— Count E. De V. Vermont, author of "America Heraldica," and a publisher at 744 Broadway, this city, is no relation to the man arrested under the name of W. C. Tenner, *alias* Terrail de Vermont, for having forged various checks in New York, Canada, etc.

— The friends of *Psyche*, a journal of entomology published by the Cambridge Entomological Club, have made an appeal to entomologists for support. The limited funds of the club are not sufficient to publish the journal with the present subscription list without falling into arrears, so that the journal has been a heavy drain upon its local supporters, though several friends at a distance have generously assisted. A slight increase of the subscription list would render it nearly self-supporting, which is all the club asks, and it is believed that the special circumstances of the present time, indicated in the form of a subscription, will find a response from those interested in its welfare. Sample copies will be sent to any one desiring to call the attention of others to its character. A friend of the Cambridge Entomological Club having assured the publication of *Psyche* to the end of 1893 on condition that fifty new subscriptions to the present volume (at five dollars the volume) are received before Nov. 1, 1889, Mr. George Dimmock of Cambridge has subscribed for five copies; Mr. Samuel H. Scudder of Cambridge, for five; Mr. Roland Hayward of Boston, for two; and Mr. Holmes Hinckley of Cambridge, for one copy. Subscriptions and payments may be made to Samuel Henshaw, treasurer, Cambridge, Mass.

— "The Butterflies of the Eastern United States and Canada, with Special Reference to New England," describes in detail all the butterflies known to occur in North America east of the Mississippi, excepting such as are found only in the unsettled parts of Canada or south of Kentucky and Virginia. It was originally issued in twelve monthly parts, each containing 8 plates (colored and plain) and about 150 pages of text. The first part was published Nov. 1, 1888; the last will be published Oct. 1, 1889. As now completed, it contains 17 plates of butterflies, 6 of eggs, 11 of

caterpillars, 2 of the nests of caterpillars, 3 of chrysalids, 2 of parasites, 33 of structural details in all stages of life, 19 maps and groups of maps to illustrate the geographical distribution of butterflies, and 3 portraits of early naturalists of this country,—in all, about 2,000 figures on 96 plates, of which 41 are colored. The text contains 2,000 pages, including an introduction of 104 pages, and an appendix of 150 pages, which contains descriptions of such species concerned as have not been found within the limits of New England, and also descriptions of all known parasites of North American butterflies, by Messrs. Howard and Williston. Special attention is paid in this work to the distribution, habits, and life-histories of our butterflies; and careful descriptions are given of every stage of life, not only for the species, but for the genera and

higher groups wherever the data are attainable. Analytical tables applicable to every stage (a feature never before attempted in a work of this kind) are introduced wherever possible. Seventy-six essays scattered through the work discuss such special questions as arise in studying butterflies, and in themselves form a complete treatise on the life of these insects. The work makes three volumes: the first contains the introduction and the family *Nymphalidae*; the second, the remaining families of butterflies; the third, the appendix, plates, and a full index. Explanations of the plates are placed beside them. The price, bound in three volumes, half levant, gilt top, is \$75. It will be ready for delivery, bound, Oct. 1, 1889. Communications concerning it should be addressed to Samuel H. Scudder, Cambridge, Mass.

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— The London correspondent of *The New York Times* says, "The *New Review* has been such a remarkable success that it will henceforth contain ten additional pages. Its freshness, ability, and scope have made even the *Fortnightly* and the *Contemporary* seem dull by comparison, and this month in the table of contents it easily leads all its older and costlier rivals. A little two-page paper by Cardinal Manning on the strike is one of the wisest and most valuable deliverances on the subject I have ever seen, and John Burns's longer article is extremely forcible."

— In the *New England Magazine* for October many of the articles are devoted to subjects relating to education. Mr. Albert P. Marble, the retiring president of the National Educational Association, contributes an article on the history and prospects of the association; W. A. Mowry, the editor of *Education*, writes on Dr. Harris and the Bureau of Education; there is a brief article on history, by A. E. Winship, the editor of the *New England Journal of Education*; and there is a long and fully illustrated article on the educational institutions of Nashville. Nashville receives further notice in a general article on the history and new life of the city, by Hon. A. S. Colyar. This article also is illustrated, and is timely, as the recent meeting of the National Educational Association in this "Athens of the South" has drawn to it the attention of thousands of the teachers of the country. It is the first of a series of articles, in which the *New England Magazine* proposes to present the enterprising cities of the New South to Northern readers. Dr. Holmes, whose eightieth birthday has just been celebrated, receives attention in this number of the magazine. The frontispiece is a portrait of Dr. Holmes, from a recent photograph. There is an illustrated article, "Dr. Holmes at Fourscore," by George Willis Cooke; an article on "Dr. Holmes's Pilgrim Poems;" and interesting facts about the poet among the editorial notes. Professor Hosmer's story, "The Haunted Bell," is continued, and there are some short stories, one by Mrs. Celia P. Woolley, the author of "Love and Theology." Mr. Mead's study of the question, "Did John Hampden come to New England?" is finished, the whole evidence on this puzzling point being laid on the table. Another historical article is by Professor Charles H. Levermore, "Pilgrim and Knickerbocker in the Connecticut Valley." Mr. Hale has a gossip paper entitled "Tarry at Home Travel," not easy to describe, but delightful to read. There is a brief article on John Boyle O'Reilly; and a long and thorough one by William Clarke of London on Parnell, which will attract much attention. It is accompanied by a portrait of Parnell, from a recent photograph. The articles on O'Reilly and Dr. Harris also have portraits.

— Messrs. Houghton, Mifflin, & Co. have published a small volume by Mary E. Burt, an Illinois teacher, entitled "Literary Landmarks." The authoress is impressed with the importance of giving children a taste for better reading than much that they now indulge in, and more knowledge of the literary history of the world. She lays the most stress on works of imagination, though she does not neglect scientific and historical books, and others that convey information. She gives some account of her experience in teaching the history of literature by means of specimen works, — a study which she has found more interesting to school-children than is commonly supposed. The book contains some charts to illustrate the literary history of the world, one of which is quite elaborate, and would, we should think, be useful to other teachers. Miss Burt is perhaps a little too positive in expressing her views, and the list of books that she recommends for young people is too full for ordinary use; but we welcome her attempt and all attempts to raise the standard of juvenile reading.

— "Evolution of Morals," by Lewis G. Janes, and "Proofs of Evolution," by Nelson C. Parshall, are the contents of Nos. 11 and 12 of the *Modern Science Essayist*.

LETTERS TO THE EDITOR.

Lightning-Strokes.

THE attempt of *Science* to obtain information regarding lightning-strokes and their damage is very praiseworthy, and it is to be hoped that it will result in a clearer understanding of the danger

from these strokes to unprotected houses. I have heard intelligent men say that a lightning-rod attracted the lightning, and was more dangerous than none. This is unquestionably an entirely erroneous supposition, in case the lightning-rod has a good ground, for its whole duty is to cause electricity of increased tension to pass off silently and insensibly, rather than to gain a sufficient potential to give a disruptive discharge. The following is a brief account of a few strokes that have come to my attention, in which damage resulted, in the past four years.

On Aug. 23, 1885, a church with a high steeple, and protected by an iron lightning-rod, was struck in a severe storm. The stroke stopped the tower clock, but without serious injury. The electricity came down the rod to within fifteen feet of the ground, when it dashed across twenty feet of air space, to a faucet connected with the city water-pipes, and disappeared without further injury. It slightly dazed a man who was within a few feet of the line from the rod to the faucet. A singular point is, that this same church was struck in precisely the same way several years before; and on that occasion, as the stroke entered the water-pipe, it broke the marble front of the sink, and threw it on the floor. It is very plain that the whole difficulty in this case was an insufficient ground. After the last catastrophe the rod was changed to copper, but it is plain that the only method of avoiding danger is by improving the ground.

In this same storm, lightning struck a house about three-quarters of a mile from the church. This house had no rod. The main part had a hip roof, and was shingled; while a lower southern extension had a tin roof, from the south-west corner of which a tin eaves-spout ran down to about ten inches above the earth. The lightning struck the south-west corner of the extension, and divided, a part going down to the end of the spout, and then into the house, where it knocked off the plastering. The other part crossed to the north-east corner, passed down between the weatherboarding and plastering, and finally dug a furrow in the ground, and disappeared in a pool of water about fifteen feet from the house. The latter part of the stroke drove off, as by an explosion, the plastering on the inside and the weatherboarding on the outside. There was no trace of scorching on the boards. A woman and her two sons in the house were dazed and partly stunned.

A year or two later a modern house was struck on one of the principal avenues of the city. It had no lightning-rod; but, from a tower having a slate roof, a gilded ornament projected to about three feet. The whole house excepting this tower was roofed with tin. The stroke passed down the inside of the tower, knocking off the plastering, stunning one of the inmates, and doing other slight damage. This house has had the same ornament erected, and no rod put in place to protect from a similar stroke.

The last stroke that has been called to my attention occurred this summer. A gilded wooden cross about four feet in height, on the tower of a beautiful stone church which had no protection from lightning, was struck. Various ornaments on the tower were shattered, and the tower itself was damaged. The whole damage was two hundred or three hundred dollars. The gilded cross has again been erected without a lightning-rod to invite another visitation by Providence.

It seems to me the architects of modern buildings are largely responsible for this state of affairs. It is probable that in a large city with numerous tin roofs the danger from lightning on ordinary roofs is very slight; but certainly in isolated spots, and all projecting metallic or gilded points, there is a constant hazard from lightning unless protected by a rod well grounded.

H. A. HAZEN.

Washington, D.C., Oct. 7.

A Queer Maple-Tree.

A HARD-MAPLE tree in the yard of S. G. Scott at Plainwell, Mich., is an object of great curiosity. It has been shedding its foliage through September, but new leaves are again appearing, and after the fall frosts the tree again drops its leaves. This it has done regularly for several seasons. It differs only in respect of shedding its foliage twice a year, from other maples standing within a few feet of it.

M. G. MANTING.

Holland, Mich., Oct. 4.

INDUSTRIAL NOTES.

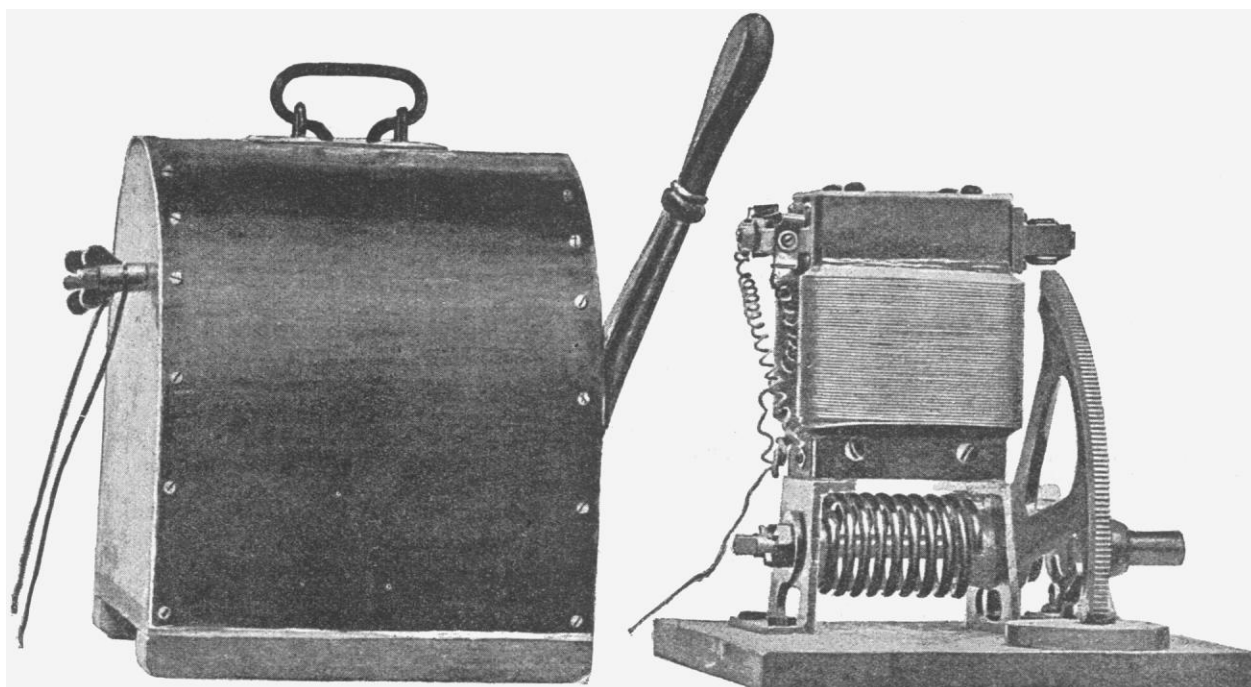
Electric Blasting Battery.

THE small dynamo-electric machine shown in the accompanying illustrations is intended for use in exploding blasts in mining and similar operations. It is called the "Crescent" battery, and is manufactured by the Ingersoll-Sergeant Rock Drill Company of this city. It is said to be the only electric blasting-machine which discharges a uniform current of electricity at every operation, no matter who may use it. Its action does not depend upon the skill of the operator, and, what is very important, there are no parts liable to break or get out of order.

The following is a description of the machine: A strong steel-wire spring is fixed to a shaft which carries a racked segment. The operator, when he presses the lever over, simply tightens the spring, and at a certain fixed point the lever is automatically released from its contact with the shaft, and the recoil of the spring gives a rapid and uniform movement to the armature, which generates the current. A nut is provided for giving greater or less ten-

motor is used, and it does its work without a hitch. It is a small arrangement, and is stowed away under the seat in the stern, where it is entirely out of the way. Two hundred and forty revolutions per minute are made by the screw, which gives the boat a speed of about five miles an hour. The boat being a very wide one, this is a very good result. There is no puffing little engine, as in a steam-yacht, heating up the little craft to an uncomfortable degree, requiring the constant attention of the engineer in shovelling coal and watching the steam-gauge, and rendering the boat top-heavy by the weight of the boiler. The batteries are directly over the keel, taking up no room which is needed, as their wood-casing makes good seats; and, as they weigh nearly five hundred pounds, they make excellent ballast.

The master of the craft moves a little lever, which starts the motor, and then, seating himself directly over it, he has nothing further to do but steer the boat. The batteries take about eight hours to discharge, and the motor will run that length of time without a particle of attention. The motor makes no jar in the boat, as an engine always does on a small boat, and the only noise



ELECTRIC BLASTING BATTERY.

sion to the spring, thus adjusting the capacity of the battery. The spring never breaks.

Those who are familiar with electric blasting will not fail to appreciate the great importance of a uniform discharge. Missfires and serious accidents are often due directly to a lack of uniform strength in the battery-current: one hole will fire while another in the same circuit will miss. With the Crescent, it is claimed that one can estimate with certainty that a certain number of holes will go off at each operation.

An Electric Boat on the Housatonic.

A BOAT propelled by electricity was first launched Sept. 20 by George G. Grower, electrician and chemist, of Ansonia, Conn.; and about 4 P.M., Monday, Sept. 23, a party, consisting of Mr. Grower, Frank A. Kirkham, and Fred Wehrle, of Ansonia, and a reporter, stepped into the boat and pushed off.

There is nothing unusual in the appearance of the boat, except a long, box-like structure extending the length of the boat over the keel. When the party was seated, and Mr. Grower pressed a little lever, the boat started up the river at a good rate of speed, although stemming a strong current, as the tide was running out.

The boat is an ordinary-sized row-boat, fourteen feet in length, and four feet wide. The structure in the centre contains the storage-battery, of fifty cells, which furnishes the power. A Perret

motor is used, and it does its work without a hitch. It is a small arrangement, and is stowed away under the seat in the stern, where it is entirely out of the way. Two hundred and forty revolutions per minute are made by the screw, which gives the boat a speed of about five miles an hour. The boat being a very wide one, this is a very good result. There is no puffing little engine, as in a steam-yacht, heating up the little craft to an uncomfortable degree, requiring the constant attention of the engineer in shovelling coal and watching the steam-gauge, and rendering the boat top-heavy by the weight of the boiler. The batteries are directly over the keel, taking up no room which is needed, as their wood-casing makes good seats; and, as they weigh nearly five hundred pounds, they make excellent ballast.

Many persons watched the craft from the shore, and they had good reason to be puzzled. The picture of a number of persons in a boat, no one being occupied except the pilot, with no oars, sails, or even a smoke-stack visible, and with the boat rushing through the water, would naturally excite the curiosity of the uninitiated.

The trip made Monday was the third one, and on no occasion has there been the slightest hitch or cause for discouragement. The Perret motor, which is used, is a light one, weighing but ninety pounds, but is of one horse-power, and is of 100 volts electro-motive force. It is very simply managed, all four of the party Monday taking a turn as "engineer," with equal success. It can be reversed quickly, and stopped instantly. It is built so that in starting the power is applied gradually to the motor, thus obviating the danger of burning out the armature.

Mr. Grower is now introducing the Perret motors into factories, where power is lost by the large quantity of shafting required. Several of the motors scattered through a factory do away with a lot of the shafting, and save a large proportion of the power which is otherwise lost.